



GAC 3.0-1XXX  
ANALOG GALVANOMETER  
CONTROLLER  
OPERATOR'S MANUAL

1-1-3500-950-00  
REV C

August 14, 2014

Please check with Lincoln Laser for the latest version of this Operator's Manual

*\*Subject to change without notice\**

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# **Introduction**

This manual stipulates the Specifications, Input/Output Interface and Cautions about the GAC 3.0 series driver for Lincoln Laser supplied galvanometers.

Please read this Operator's Manual carefully to fully understand the specifications and safe operation of the product before use.

The driver and galvanometers not only malfunction, but could cause damage if they are used improperly.

Keep this manual handy for your reference even after you think that you fully understand the contents.



: This marking indicates general dangers, warnings and cautions.

**Danger:** Dangerous consequences, including death, serious injury, and fatal damage to your property could arise if you don't follow the instructions during operation of your equipment.

**Warning:** Possible dangerous consequences, including death, fire, serious injury, and serious damage to your property could arise if you don't follow the instructions during operation of your equipment.

**Caution:** Indirect consequences, including mild and moderate injuries and partial damage to your property could arise if you don't follow the instructions during operation of your equipment.

**Caution:** Galvanometers and Controllers MUST be operated at the same voltage used to perform the factory tuning or damage may result to the Motor and/or the Controller.

Galvanometers and Controllers are tuned as a matched pair, failure to operate as a pair may result in damage to the Motor and/or Controller. Tuning voltage and paired serial numbers can be found on the Galvanometer Final Inspection Data Sheet

**Attention:**

**DO NOT REPRINT THIS USER MANUAL WITHOUT OUR PERMISSION.**

**INSTRUCTIONS AND INFORMATION CONTAINED IN THIS MANUAL ARE SUBJECT TO CHANGE FOR UPDATING.**

# **1. Specifications**

1. Model: GAC 3.0 – 1XXX

2. Application: Lincoln Laser Galvanometer Scanner PHX Series

3. Main Specifications:

- Input Voltage:  $\pm 15$  to  $\pm 24\text{VDC} \pm 10\%$  (Capable of supplying  $\geq 5\text{Amps}$  is recommended) <sup>1</sup>  

<sup>1</sup> Alteration of the Power Supply Voltage may require retuning of the system
- Drive Principle: Linear Drive
- Zero Position Hold Current:  $\approx +160\text{mA}$ ,  $-120\text{mA}$
- Max Output:  $\approx 240\text{W}$

4. Input Signal:

- Position Command Input: Voltage Range  $\pm 3.0\text{V}$  p-p or  $\pm 10.0\text{V}$  p-p (Differential Input)  
(Single ended input is possible)

5. Output Signal:

- Position Signal Output: Position Command Input and Position Signal Output voltage ranges are the same.

6. Protective Functions: Overheat

Over-position  
Over-current  
Sensor malfunction

7. Ambient Operating Conditions:

- Temperature:  $0^\circ\text{C}$  to  $+50^\circ\text{C}$
- Humidity: Non condensing, 10% to 85% RH

8. Configuration:

- Construction: Open Frame Type
- Outside Dimension: 93mm long x 57.5mm wide x 31.0mm high
- Weight: 60g (with heat sink)

9. Accessories:

- Connector (cable-side)
- Header CN1: DF1B-4S-2.5R                      Power Supply                      1 pc
- Header CN3: DF1B-5S-2.5R                      Control Signal I/O                      1 pc
- Contact pin: DF1B-2428SCA                      12pcs

- \* For AWG 24 Wire
- \* Crimp Tool not included.

## **2. Description of Driver**

This product is a position-controlling servo to linearly drive the galvanometers supplied by Lincoln Laser.



**This driver cannot be used with the galvanometers made by other companies**



**Caution: Do not remove the heat sink from the driver when you use it, damage from overheating could result.**

### **3. I/O Connector**

#### **1. Connector - CN1 Power Input**

Manufacturer: Hirose Electric Co. LTD

Model #: DF1B-4P-2.5SA (01) (For board-side)

DF1B-4S-2.5R (For cable-side)

DF1B2428SCA (For cable-side)

# 24 AWG is the recommended minimum cable wire size

The connector pins should be crimped to the cable using the manufacturers recommended crimp tool

Terminal #	Signal / Function
1	FG
2	DC + Power input
3	GND
4	DC - Power Input

**CAUTION: Do not exceed the maximum rated voltage.**



**Reversal of voltage polarities will result in damage to the controller.**

#### **2. Connector - CN2 Position Sensor Input**

Manufacturer: Hirose Electric Co. Ltd.

Model #: DF1B - 10DP - 2.5DS (01) (board-side)

DF1B - 10DS - 2.5RC (galvanometers optical scanner-side)

DF1B - 2428SCA (galvanometers optical scanner-side)

Terminal #	Signal / Function
1	Position Signal Input 1
2	Position Signal Input 2
3	GND
4	GND
5	AGC
6	Frame Ground
7	Frame Ground
8	Frame Ground
9	(-) motor winding
10	(+) motor winding



**Connect only with galvanometer scanners supplied by Lincoln Laser.  
Not for use with scanners made by other companies.**

### 3. Connector - CN3 Control Signal Input/Output

Manufacturer: Hirose Electric Co. LTD

Model #: DF1B-5P-2.5DSA (01) (board-side)

DF1B-5S-2.5R (cable-side)

DF1B-2428SCA (cable-side)

Please refer to Section 4 (page 9) for the details of the Input/Output interface.

# 22 AWG is the recommended minimum cable wire size

The connector pins should be crimped to the cable using the manufacturer's recommended crimp tool

Terminal #	Signal / Function
1	+ Position Command Input
2	- Position Command Input
3	GND
4	Servo Enable Input
5	Ready Output

### 4. Connector CN4 - Motor Connector

Manufacturer: J. S. T. Mfg. Co. Ltd.

Model #: B3PS - VH (board-side)

VHR - 3N (galvanometer side)

- Supplies the voltage to drive the galvanometer.  
Not Applicable to Models PHX 030, 050, 075
- The connector is UL-approved (File No. E60389) and CSA-approved (File No. 20812)
- Recommended wire size is # 16 to # 22 AWG

Terminal #	Signal / Function
1	Frame Ground
2	- pole of motor winding
3	+ pole of motor winding



**Connect only with galvanometer scanners supplied by Lincoln Laser. Do not connect with scanners made by other companies.**

Manual crimping tools for the accessory connectors on the cable-side for CN1 and CN3 are available. (Not provided with this driver).

Model
AP105-DF1B2428S
DF1B-TA2428SHC

## 5. Monitor Signal Output Connector - CN5

Manufacturer: JST Mfg. Co. Ltd.

Model #: RE - H (04) 2TD - 1130 (board-side)

RE - 02 (cable-side)

RE - 02 (cable-side)

Please refer to Section 4 (page 9) for the details of Input/Output interface.

Terminal #	Signal / Function
1	+ Position signal output
2	Scanner current output
3	Position error output
4	Speed output

## 6 · Monitor Signal Output Connector - CN6

Manufacturer: J. S. T. Mfg. Co. Ltd.

Model #: RE - H (02) 2TD - 1130 (board-side)

RE - 02 (cable-side)

RF - SC2210 (cable-side)

- An Alarm pulse is present when a fault has occurred.
- Please refer to Section 4 (page 9) for the details of Output interface.

Terminal #	Signal / Function
1	Alarm pulse output
2	GND

## 7 · Monitor Power Supply Output Connector - CN7

Manufacturer: J.S.T. Mfg Co Ltd.

Model #: RE - H (02) 2TD - 1130 (board-side)

RE - 02 (cable-side)

RF - SC2210 (cable-side)

+/-12VDV Power Supply Output Monitor Signal. Capable of sourcing 300mA (Max)

Terminal #	Signal / Function
1	DC +12V Power output
2	DC -12V Power output


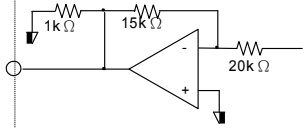
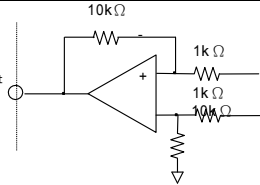
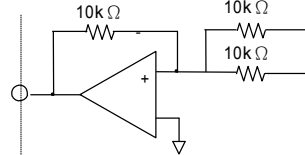
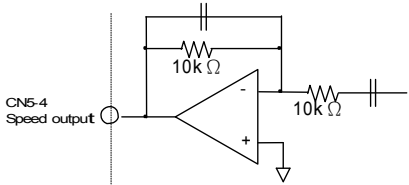


## 4. Input/Output Interface Description

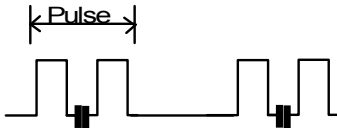
### Connector - CN3 Control Signal Input/Output

Signal Name Terminal #	Function	Interface
Position Command Input (CN 3-1, 3-2)	Input Command Voltage.  For Single Ended Input, CN3-2 is shorted to CN3-3 and the (+) input should be made to CN3-1.	
Servo Enable Input (CN 3-4)	This command enables position control of the scanner. Enable by shorting to GND (Active LOW). Gain is lowered at the servo when not Enabled. <i>It Is NOT Servo OFF.</i>	
Ready Signal Output (CN 3-5)	LOW level with no Fault. HI level (+5V) in Fault condition.	


## Monitor Signal Output Connector - CN5


Signal Name Terminal #	Function	Interface
Position Signal Output (CN5-1)	Scale: 1/2 Actual voltage.  <b>Caution:</b> This terminal must not be connected to GND.	
Scanner Current Signal Output (CN5-2)	Scale: 1volt = 1 amp	
Position Error Output (CN5-3)	Error level between Input Command and Motor Position	
Speed Output (CN5-4)		

## Monitor Signal Output Connector - CN6

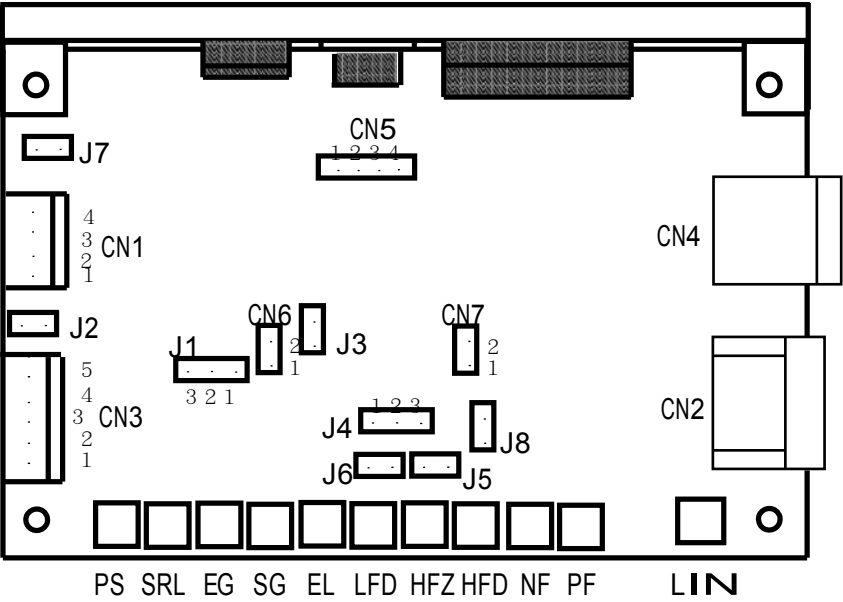
Signal Name Terminal #	Function														
Alarm Pulse Output (CN6-1)	<p>Alarm pulse is present when a fault has occurred. The number of pulses indicates the type of fault.</p>  <table border="1"> <thead> <tr> <th>Pulse(s)</th> <th>Fault Type</th> </tr> </thead> <tbody> <tr> <td>1 ...</td> <td>Sensor error</td> </tr> <tr> <td>2 ...</td> <td>Over current</td> </tr> <tr> <td>3 ...</td> <td>Over heat</td> </tr> <tr> <td>4 ...</td> <td>Over position</td> </tr> <tr> <td>5 ...</td> <td>Power voltage error</td> </tr> <tr> <td>6 ...</td> <td>Over position (latch)</td> </tr> </tbody> </table>	Pulse(s)	Fault Type	1 ...	Sensor error	2 ...	Over current	3 ...	Over heat	4 ...	Over position	5 ...	Power voltage error	6 ...	Over position (latch)
Pulse(s)	Fault Type														
1 ...	Sensor error														
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4 ...	Over position														
5 ...	Power voltage error														
6 ...	Over position (latch)														

## 5. Tuning Parameter Description

Potentiometer	Description
PS	<p><b><u>Adjustment of Position Command Input Scale</u></b></p> <p>You can adjust the voltage scale of the Position Input and Position Output. This will also fine adjust the max scan angle. The voltage scale is reduced (the max scan angle is reduced) as it is turned in the CCW direction.</p> <p style="text-align: center;">  <b>A voltage differential may appear between Position Command Input and Position Output when this parameter is adjusted.</b> </p>
SRL	<p><b><u>Adjustment of the Position Command Slew Rate.</u></b></p> <p>Adjusts the Slew rate for a large step. The response increases when it is turned to CCW direction. The maximum rate will depend on the load inertia and power supply current capacity.</p>
EG	<p><b><u>Adjustment of Position Deviation amplifier</u></b></p> <p>Adjusts acceleration of scanner. Acceleration is increased when turned in the CW direction.</p>
SG	<p><b><u>Adjustment of the Proportional Gain of the Position Signal</u></b></p> <p>The leading overshoot can be reduced at position stabilization.</p>
EL	<p><b><u>Fine Adjustment of Error Limiter</u></b></p> <p>Adjusts Large step response. Please use when P control is selected. The response speed increases when it is turned in the CCW direction.</p>
LFD	<p><b><u>Adjustment of the Derivative Gain of the Position Signal</u></b></p> <p>The overshoot and undershoot can be reduced at position stabilization. Effective for the low frequency component.</p>
HFZ	<p><b><u>Adjustment of Current Integral Gain</u></b></p> <p>The overshoot and undershoot can be reduced at position stabilization. Effective for the high frequency component.</p>
HFD	<p><b><u>Fine Adjustment of the Frequency Band for the Current Integral Feedback Signal</u></b></p> <p>The overshoot and undershoot can be reduced by fine adjustment at position stabilization.</p>

NF	<p><b><u>Adjustment of Notch Filter Center Frequency</u></b></p> <p>The center frequency of the notch filter can be adjusted to reduce the effects of shaft/mirror resonance. The center frequency is lowered when turned in the CW direction</p>
PF	<p>Adjustment of Position Signal Filter Circuit</p> <p>Adjusts Position Signal Filter – this will also alter the max scan angle.</p> <p>  <b>Please Contact Lincoln Laser before making this adjustment, since it will affect other factory settings.</b> </p>
LIN	<p>Non linearity is adjustable no more than 10% for your scanner combination.</p>

Location of the Tuning Parameter Potentiometers and Jumpers.



## **6. Jumper Function and Configuration**

### **1. Position Command Input Limit Menu (J1, J2, J3 and J6)**

Function	J1	J2	J3	J6
Slew rate limiter	1-2	short	open	open
Slew rate limiter and S shape circuit	1-2	short	short	open
Error limiter (for P control only)	2-3	open	--	short

### **2. Switching Control System (J4 and J5)**

Function	J4	J5
P control	1-2	open
PI control	2-3	short

### **3. GND and Frame Ground Connection (J7)**

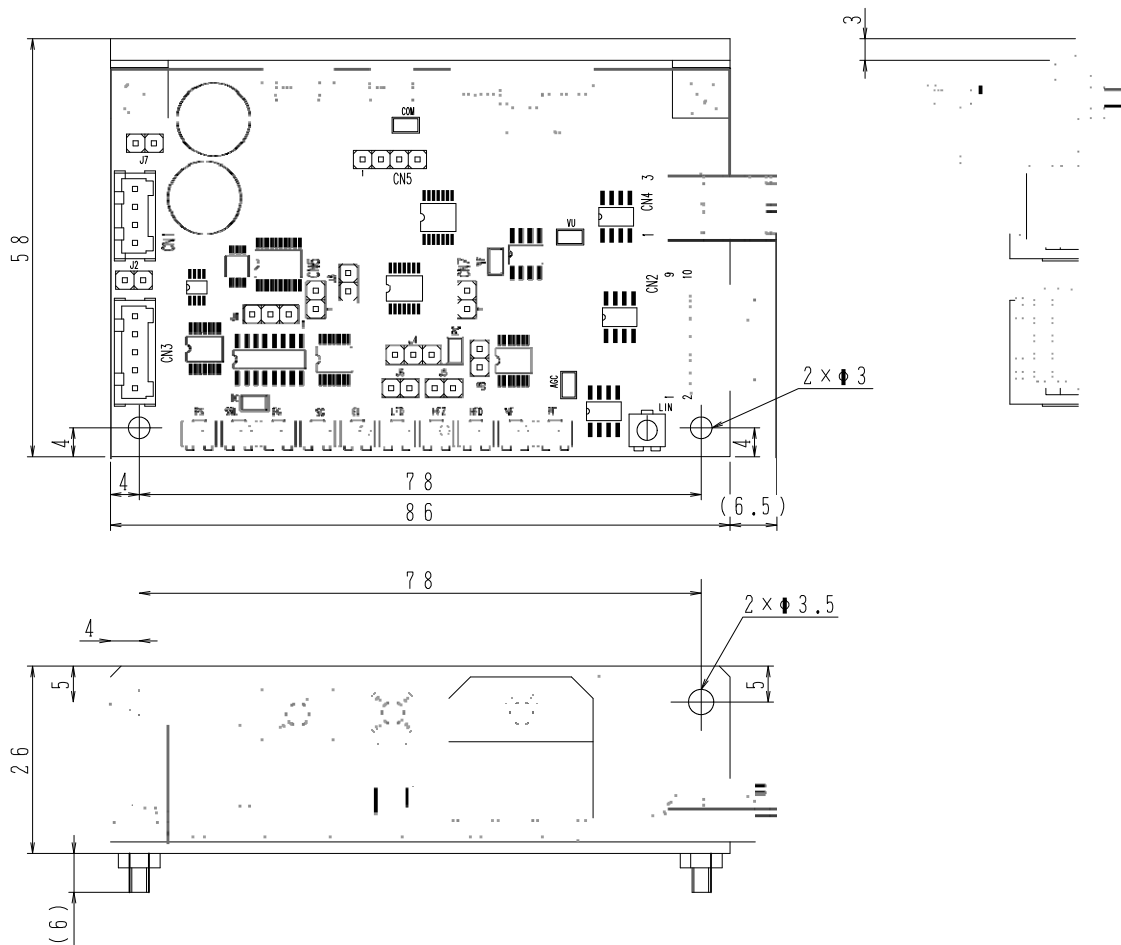
Function	J7
GND – FG (connected when shipped from our factory)	short
GND – FG (not connected)	open

### **4. J8 – Not user adjustable**

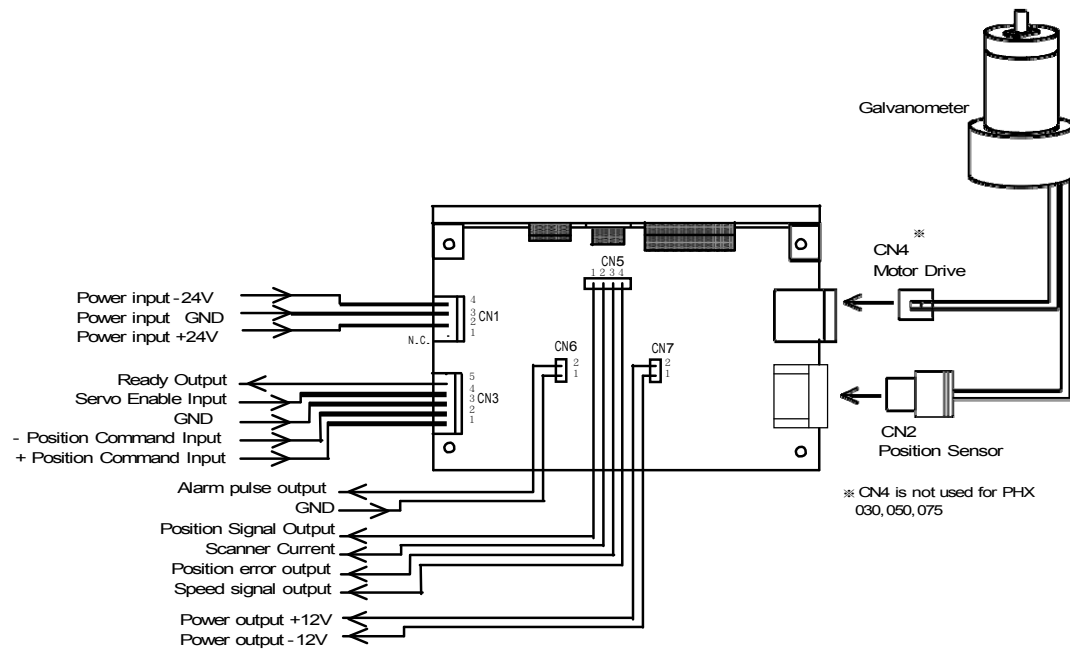
Please do not change, as this is for Lincoln Laser use only. It is setup as short.

## 7. Outline Drawing

(Dimensions in mm)

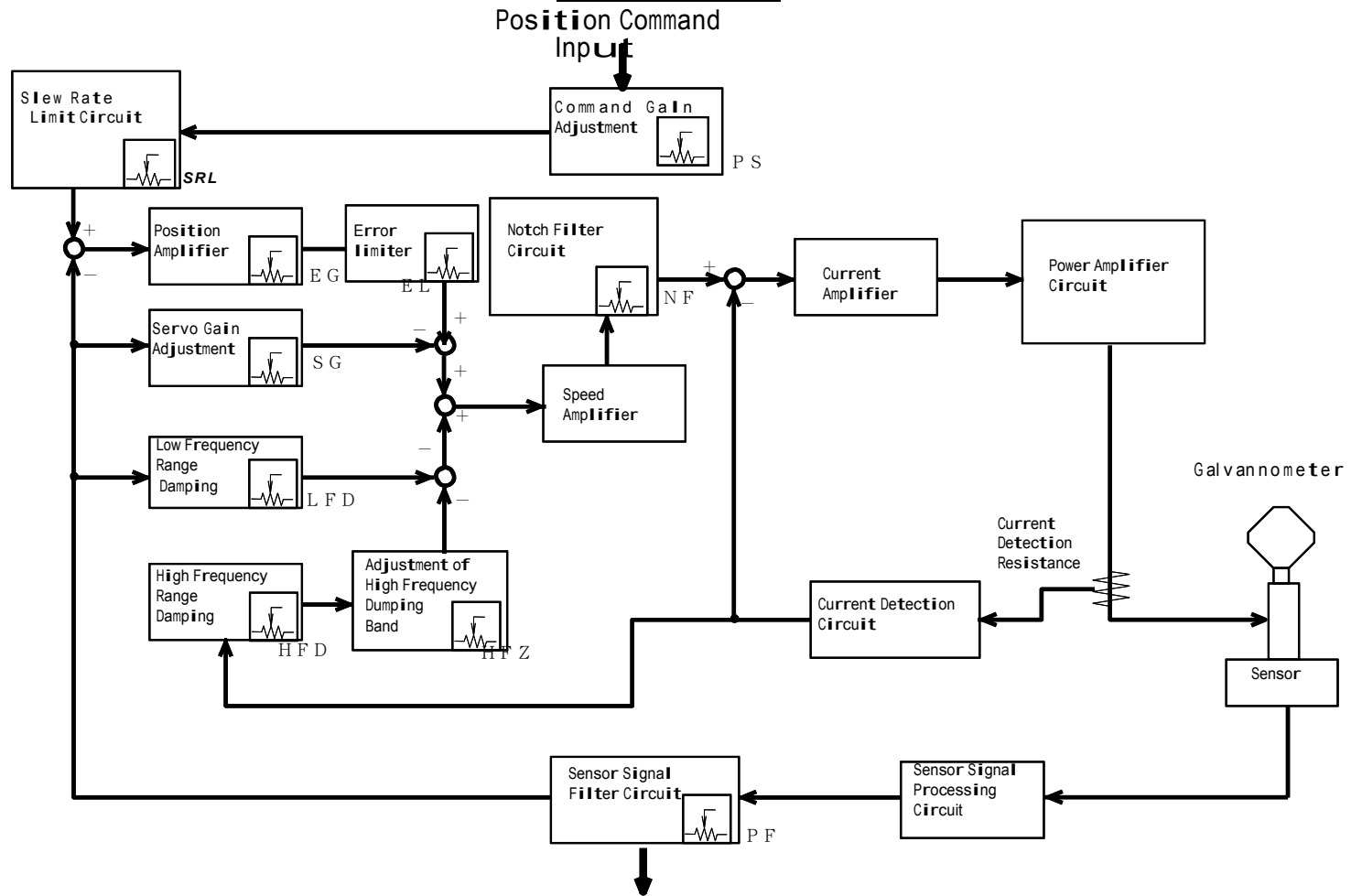


## 8. Wiring Connection Drawing





## 9. Block Diagram





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